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Professor Ford has proved that if the generated area is to be passed over, to the greatest possible extent, but *two* times, AB should be rotated about the intersection of the perpendicular bisectors of AB and $A'B'$.

DISCUSSIONS.

Doctor Morris gives a device for a perpetual calendar, with an account of the theory on which it is constructed. A similar explanation will hold for any of the many forms of such calendars. It is believed that this article will be of interest, since explanations of the theory of perpetual calendars are seldom given.

Professor Bennett gives a set of simple identities from which a four-place logarithm table can readily be calculated. The method is probably new. It bears some relation to the plan used by Briggs (cf. *Encyclopædia Britannica*, 11th ed., vol. 16, pp. 875-876); but Briggs needed first to calculate and use explicitly the modulus, while Professor Bennett does not make any use of the modulus.

I. THE THEORY OF PERPETUAL CALENDARS.

By FRANK R. MORRIS, University of California.

A short discussion of adjustable calendars is given by Irwin Roman¹ in the *MONTHLY*, 1915, 241. He describes one of the several hundred mechanical devices used in presenting the calendar of a given month of a given year, but he does not give the mathematical theory upon which practically all perpetual calendars are based. It is the purpose of this article to present this theory.

There are approximately 365.2422 days in a tropical year. If each calendar year contained 365 days, in the course of 400 years an error of 96.88 days would accumulate. Then if 97 days be added for each period of 400 years the error will be very small. In any 400 consecutive integers there are 100 numbers which are divisible by 4, and 3 which are divisible by 100 but not by 400. Hence the rule: *Each year which is divisible by 4 but not by 100 and each year which is divisible by 400 is a leap year with 366 days. All other years contain 365 days.* Since this rule was first introduced by Pope Gregory XIII in the year 1582, no calendar based upon it need antedate the sixteenth century. The calendar may be extended into the future as far as one may choose. However, it becomes inaccurate after a few thousand years, because it accumulates a day in about 3,000 years, and also because the tropical year varies slightly as the years go by. Other calendars, which are used in some parts of the world or have been used in the past, are built upon other rules but I shall discuss only that calendar

¹ Mr. Roman's article begins with the statement, "So far as the writer has been able to learn, all perpetual or adjustable calendars are arranged so as to present the first day of the month as the first day of the week." He had evidently overlooked the most fruitful field for the study of perpetual calendars, viz., the *Official Gazette* of the United States Patent Office. During the past 25 years more than 100 calendars have been patented and more than a score of these present the days of the week in the natural order. For example see number 1048413, Dec. 24, 1912. [Doctor Morris's perpetual calendar was patented Nov. 26, 1918, number 1286058.—EDITOR.]